Check List the journal of biodiversity data

NOTES ON GEOGRAPHIC DISTRIBUTION

Check List 18 (2): 369–384
https://doi.org/10.15560/18.2.369

PENSOFT

Additional records of small mammals collected from Nepal

Nelish Pradhan, C. William Kilpatrick*

University of Vermont, Department of Biology, Burlington, Vermont, USA • NP: npradhan@cibio.up.pt • CWK: wkilpatr@uvm.edu
* Corresponding author

Abstract

Small mammals were surveyed in areas of the Annapurna Conservation Area, Shey Phoksundo National Park, and the Manaslu Conservation Area between 2013 and 2015. We collected 117 specimens representing 10 species of small mammals from two orders, Soricomorpha and Rodentia. We report on localities sampled from Central Nepal expanding known distributions and reporting new sampling localities for *Apodemus gurkha* Thomas, 1924; *Apodemus pallipes* (Barrett-Hamilton, 1900); *Mus musculus* Linnaeus, 1758; *Niviventer fulvescens* (Gray, 1847); *Rattus rattus* (Linnaeus, 1758); *Rattus pyctoris* (Hodgson, 1845); *Rattus nitidus* (Hodgson, 1845); and *Soriculus nigrescens* (Gray, 1842). Specimens collected from the Manaslu Conservation Area, which had not been previously surveyed, documented the occurrence of four species between previously known collection localities in the Kali Gandaki Valley and the Langtang and Khumbu valleys. Distribution records of *Episoriculus soluensis* Gruber, 1969 in Nepal are clarified for this recently recognized species.

Keywords
Manaslu Conservation Area, Nepalese Brown-toothed Shrew, Nepalese Field Mouse, White-footed Indochinese Rat

Academic editor: Krizler Tanalgo | Received 23 November 2021 | Accepted 22 February 2022 | Published 19 April 2022

Citation: Pradhan N, Kilpatrick CW (2022) Additional records of small mammals collected from Nepal. Check List 18 (2): 369–384. https://doi.org/10.15560/18.2.369

Introduction

Pearch (2011) provided a history of the mammalian surveys conducted in Nepal between the early 1820s and 2001. Brian Houghton conducted some of the earliest surveys of mammalian biodiversity in Nepal (Hodgson 1832, 1835, 1836a, 1836b, 1840, 1841a, 1841b, 1841c, 1841d, 1842, 1845, 1846), collecting more than 370 specimens representing 70 genera and 114 species; of these specimens 40 are type material (Mitchell 1975). Hinton and Fry (1923) and Fry (1925) cataloged the specimens collected on three expeditions organized by the Bombay Natural History Society in the early 1920s. The results of later surveys by the Smithsonian Institution and the Zoological Survey of India were reported by Johnson et al. (1980) and Biswas et al. (1955, 1957), respectively. A number of surveys conducted in the mid-1900s focused on ectoparasites associated with small mammals (Gruber 1969; Weigel 1969; Martens and Niethammer 1972; Mitchell and Derksen 1976; Mitchell 1979, 1980). Abe (1971, 1977, 1982) surveyed small mammals in the Langtang and Annapurna regions between 1968 and 1975, and several smaller surveys for small mammals were conducted in the late 1900s and the early 21st century by Gregori and Petrov (1976), Daniel and Hanzák (1985), Newton et al. (1990), and Mekada et al. (2021). Between 2013 and 2015, Poulton (2019) live-trapped small mammals (n = 792) from four geographic localities and

©The authors. This is an open access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

confirmed the identities of 18 taxa with cytochrome-*b* sequences, and between 2014 and 2016, Adhikari et al. (2016) live-trapped small mammals (n = 221) from urban and wildlife habitats in Kathmandu, Pokhara, and Lumbini.

Summaries of the mammals occurring in Nepal have been published starting with Hinton and Fry (1923) and periodically updated by Fry (1925), Frick (1969), Mitchell (1975, 1978), Shrestha (1997), Majupuria and Kumar (Majupuria) (1998), Csorba et al. (1999), Baral and Shah (2008), Jnawali et al. (2011), and Thapa (2014). Ellerman and Morrison-Scott (1966) indicated that the mammalian fauna of Nepal consisted of 71 genera and 106 species. Shrestha (1997) listed 212 species, whereas Baral and Shah (2008) and Jnawali et al. (2011) listed 208 species. Thapa (2014) reduced the number to 192 species of mammals other than human and provided explanations for excluding 17 species from his checklist that had been included by Baral and Shah (2008) and Jnawali et al. (2011).

Three species of mammals are endemic to Nepal: *Myotis csorbai* Topál, 1997 (Csorba's Mouse-eared Bat); *Apodemus gurkha* Thomas, 1924 (Nepalese Field Mouse); and *Neodon nepalensis* Pradhan, Sharma, Sherchan, Chhetri, Shrestha & Kilpatrick, 2019 (Nepalese Mountain Vole). *Apodemus gurkha* is known from a small area in Central Nepal where it has been collected from a few localities in both the eastern and western temperate and coniferous forest (Mitchell 1977; Musser et al. 1996; Pearch 2011). The Nepalese Field Mouse has been classified as Endangered by the IUCN due to its small range and habitat loss and fragmentation (Molur et al. 2005).

Fieldwork was conducted in Central Nepal in the summers of 2013–2015 with the primary focus of collecting additional material from Nepalese Feld Mice for phylogenetic and phylogeographic analyses of molecular data generated from this new material. During this fieldwork, nine species of non-volant small mammals were collected in addition to 48 specimens of the Nepalese Field Mouse. Examination of the collected voles has resulted in the detection of a previously undescribed mountain vole, *Neodon nepalensis*, from western Nepal (Pradhan et al. 2019). Both volant and terrestrial small mammals are poorly sampled from Nepal, and Jnawali et al. (2011) indicated that 48% of Nepalese small mammals have an IUCN status of Data Deficient. Thus, our objective here is to report the distributional data obtained from this fieldwork.

Study Area

Annapurna Conservation Area (ACA). This is the largest protected area in Nepal (7,629 km^2) and is located in the Annapurna range of the Himalayas at elevations ranging from 790 to 8,091 m a.s.l. Three areas were surveyed (Fig. 1), including:

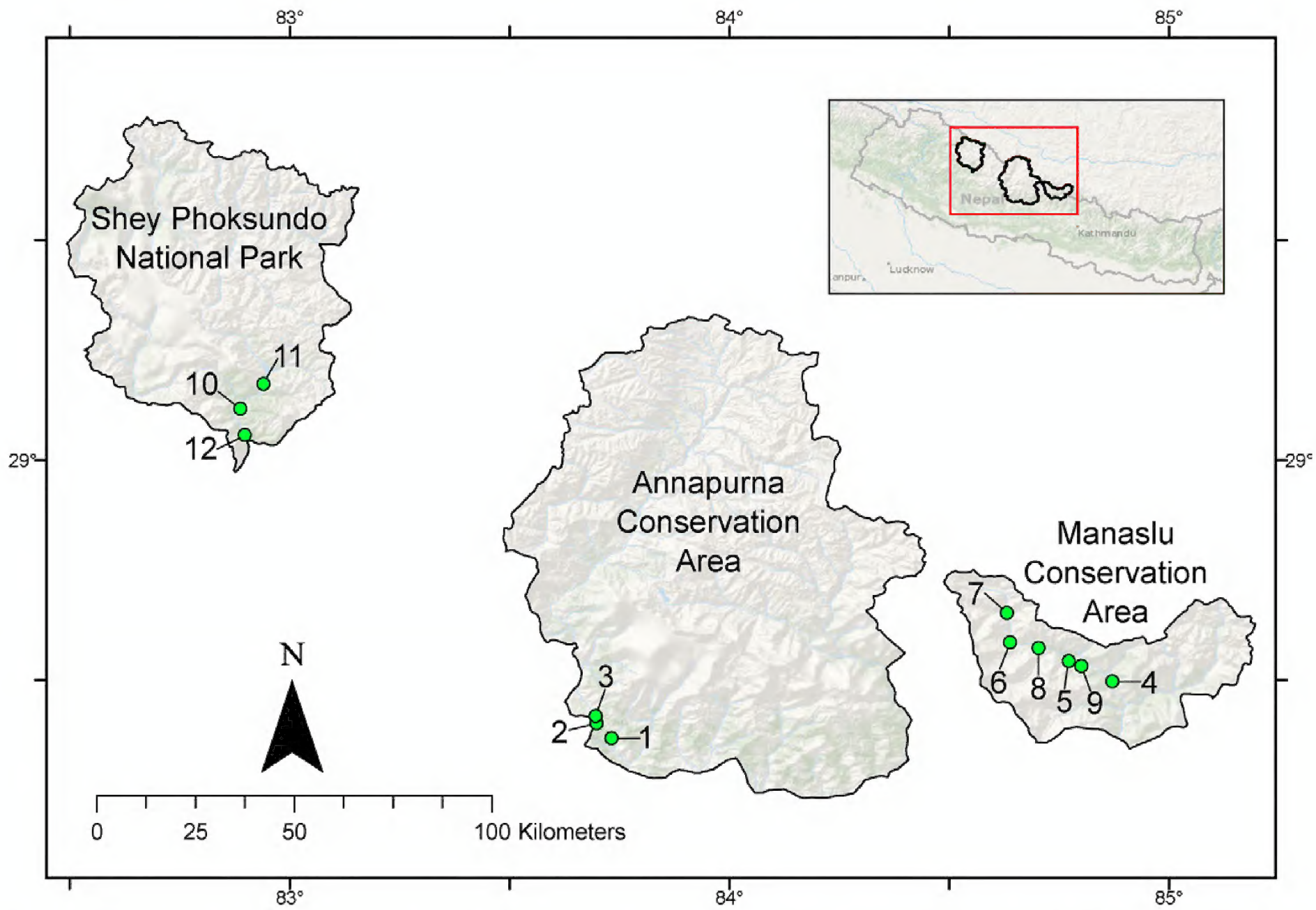

Figure 1. Map of Nepal showing collecting localities in the three study areas: 1 = Banthanti, 2 = Ghorepani, 3 = Chitre, 4 = Bihi, 5 = Numrung, 6 = Samagaun, 7 = Samdo, 8 = Lho, 9 = Kalsang, 10 = Renchi, 11 = Ringmo, and 12 = Chepka.

(**1**) Banthanti, Kaski District (28.3682°N, 083.7315°E, 2330 m a.s.l.)—a village with terraced vegetable fields and forests with rhododendron (*Rhododendron* L. spp.), oak (*Quercus* L. spp.), other broad-leaved trees, and some conifers. The forested area had moderate numbers of moss-covered rocks, dense undergrowth, and several streams, likely due to monsoon rains.

(**2**) Ghorepani, Myagdi District (Forest site 1, 28.4026°N, 083.6978°E, 2895 m a.s.l.; Forest site 2, 28.4015°N, 083.6980°E, 2820 m a.s.l.; Poon Hill, 28.4013°N, 083.6968°E, 2970 m a.s.l.)—a village located on the edge of dense rhododendron forest with dense growth of ferns and shrubs. Moving upslope on to Poon Hill, the rhododendron forest has a few conifers (*Pinus* L. spp. and *Abies* Miller spp.) transitioning into meadows with woody shrubs.

(**3**) Chitre, Myagdi District (28.4178°N, 083.6963°E, 2530 m a.s.l.)—an area of rhododendron and oak forest with few conifers (*Pinus* spp. and *Abies* spp.) fenced off from grazing pastures and agricultural lands; understory vegetation (sparser than Ghorepani and Banthanti) with ferns, and moss-covered woody debris and rocks.

Manaslu Conservation Area (MCA). This conservation area encompasses 1,663 km^2 in the Mansiri Range of the Himalayas at elevations between 1,400 and 8,156 m a.s.l. Six areas were surveyed (Fig. 1), including:

(**4**) Bihi, Gorkha District (28.5002°N, 084.8671°E, 2000 m a.s.l.)—an area of coniferous forest (*Tsuga* (Endlicher) Carriere spp. and *Pinus* spp.) with a moderately closed canopy. Area was rocky with sparse ground-level vegetation consisting of young hardwoods, wildflowers, herbs, and grasses.

(**5**) Namrung, Gorkha District (28.5439°N, 084.7700°E, 2660 m a.s.l) is an area of mixed conifer (*Tsuga* spp. and *Pinus* spp.) and hardwood (*Quercus* spp. and *Betula* L. spp.) forest with dense understory of woody stems, ferns, and moss-covered rocks.

(**6**) Samagaun, Gorkha District (Site 1, 28.5873°N, 084.6389°E, 3455 m a.s.l.; Site 2, 28.6079°N, E, 084.6381°E, 3590 m a.s.l.) included two trapping sites, one (0.6 km NW of Samagaun) with sparse conifer (*Juniperus* L. spp.) cover and understory vegetation of alpine meadows with grasses, wildflowers, and shrubs (*Sorbus* L. ssp.) and a second (2.6 km N of Samagaun) with shrubs, grasses, and wildflowers transitioning to conifers (*Juniperus* spp. and *Abies* spp.) and shrubs (*Sorbus* spp.) with low height but dense canopy.

(**7**) Samdo, Gorkha District (28.6520°N, 084.6317°E, 3825 m a.s.l.) is an alpine meadow with grasses, shrubs (*Sorbus* spp.), and wildflowers located between a rocky riverbed and cultivated potato fields.

(**8**) Lho, Gorkha District (28.5741°N, 084.7031°E, 3180 m a.s.l.)— an area of mixed coniferous-deciduous forest (*Tsuga*, *Pinus*, *Quercus*, and *Betula* spp.) located on a steep slope near the village. Leaf litter was present at this site with moderate herbaceous ground cover.

(**9**) Kalsang, Gorkha District (28.5328°N, 084.7972°E, 2290 m a.s.l.)—an area of mesic hardwood forest with rhododendron, oak, and few conifers (*Tsuga* spp. and *Pinus* spp.), with ground cover consisting of small hardwoods, ferns, and shrubs and moss-covered rocks.

Shey Phoksundo National Park (SPNP). This is the only National Park in Nepal. It encompasses 3,555 km^2 at elevations between 2,130 and 6,885 m a.s.l. in the Trans-Himalayas of northwestern Nepal. Three areas were surveyed (Fig. 1), including:

(**10**) Renchi, Dolpo District (29.1173°N, 082.8873°E, 3030 m a.s.l)—an area predominantly with coniferous forest (*Pinus* spp. and *Picea* L. spp.) and a few hardwoods. Understory was sparsely vegetated with ferns and other herbaceous plants.

(**11**) Ringmo, Dolpo District (site on the southwest shore of Lake Phoksundo (alternatively spelled "Phoksumdo"), 29.1690°N, 082.9402°E, 3650 m a.s.l.—vegetated with thorny scrubs (*Caragana* Komarov spp. and *Lonicera* L. spp.), and sparse hardwood (*Betula* spp.) and conifer cover (*Cedrus* Trew spp., *Pinus* spp., and *Picea* spp.); (site on the southeast shore, 29.17340°N, 082.9363°E, 3635 m a.s.l.)—vegetated with conifers (*Cedrus* spp., *Pinus* spp., and *Picea* spp.) and herbaceous ground cover which transitions into dry grassland with wildflowers.

(**12**) Chepka, Dolpo District (29.0574°N, 082.8976°E, 2690 m a.s.l.)—alternatively spelled "Sepka"; an area of hardwood (*Quercus* spp.) and coniferous (*Pinus* spp. and *Picea* spp.) forest with dense understory of herbaceous plants and wildflowers next to cultivated areas.

Methods

Field methods. Small terrestrial mammals were collected following methods approved by the American Society of Mammalogists (Sikes and The Animal Care and Use Committee of the American Society of Mammalogists 2016) using Sherman live traps (7.62 × 8.89 × 22.86 cm) baited with oats. Traps were set in a line, selecting sites with traces of animal sign or that appear to provide cover in the late afternoon and checked early the following morning. Collecting was conducted in 2013 under permit no. 10/070/071 and in 2014 and 2015 under permit no. 1/2071/72.

Captured individuals were identified with dichotomous keys (see Appendix, Dichotomous keys used to identify small mammal species in Central Nepal). Tissue (ear punches) was collected from live specimens as a tissue source for DNA sequencing and assigned identification numbers associated with collecting locality. Specimens were measured, photographed, and examined for determination of gender and the presence of ectoparasites before being released. Specimens found dead in the live traps were prepared as voucher specimens and deposited in the Central Department Zoology Museum of Tribhuvan University in Katmandu under the accession numbers CDZ MTU-MRO51 to CDZ MTU-MRO58

and CDZ MTU-MEU31 to CDZ MTU-MEU36. Liver tissue was collected from these voucher specimens for DNA sequencing.

Molecular methods. DNA extraction and sequencing were carried out at the Center for Molecular Dynamics, Katmandu, Nepal (CMDN). Approximately 25 mg of ear or liver tissue stored in 95% ethanol was used for DNA extractions which were conducted using the DNeasy Blood and Tissue Kit (Qiagen, Germany). Tissue samples were air dried for 30 min prior to extraction. Each tissue sample was cut into small pieces (~20) and incubated at 56 °C in 180 µl of ATL (Tissue Lysis Buffer) and Proteinase K in a shaking incubator until the tissue samples were completely lysed. DNA was finally eluted in 50 µl of elution buffer and the quantity and quality of the extracted DNA was assessed on a NanoVue Plus (GE Healthcare Life Sciences) spectrophotometer.

Cytochrome *b* (*Cytb*) was amplified with the primer pairs: L14274/H15915 (Irwin et al. 1991) using an initial denaturation at 94 °C for 5 min followed by 31 cycles of denaturation at 95 °C for 1 min, annealing at 50 °C for 1 min and extension at 68 °C for 1 min, and final extension at 68 °C for 10 min. Amplification reactions were conducted in 25 µl volumes (H_2O – 16.9 µl; 5X PCR buffer+ $MgCl_2$ – 5 µl; 5000 U Taq Polymerase – 0.125 µl; 10 pMol/µl forward primer – 0.75 µl; 10 pMol/µl reverse primer – 0.75 µl; 10 mM dNTPs – 0.50 µl; DNA template – 1 µl) using OneTaq DNA Polymerase (NEB, Ipswich, Massachusetts, USA). PCR products were visualized with ethidium bromide after gel electrophoresis on 2% agarose gels. ExoSAP (Exonuclease and Shrimp Alkaline Phosphatase) (ThermoFisher Scientific) was used to purify the PCR products following manufacturer's protocol prior to sequencing reactions. Sequencing reactions (10 µl) were conducted with 1 µl of ExoSAP product, 3 µl primer (5 µM/µl), 2 µl nuclease free water, and 4 µl of Ready reaction mix containing fluorescent tagged terminator (BigDye v. 3.1; Applied Biosystems Foster City, California, USA). The sequencing reaction was further purified using Big Dye X-Terminator Purification Kit (ThermoFisher Scientific) (45 µl SAM solution + 10 µl Big Dye X-terminator solution along with all sequencing PCR product (10 µl) in a 0.5 ml tube. The reactions were optimally diluted in ABI 310 Sequencing Strip tubes for running the final sequencing reaction on ABI 310, avoiding the formation of any air bubbles in the strip tubes.

Chromatograms outputted from the sequencers were visualized and edited in Chromas v. 2.6.2 (Technelysium: http://technelysium.com.au/wp/chromas/). Sequences of the mitochondrial gene *Cytb* (1140 bp) was used for species verification and identification by use of MegaBLAST (Morgulis et al. 2008) comparisons with reference sequences in GenBank (https://www.ncbi.nim.nih.gov/genbank/). Sequences of *Cytb* of representative taxa from Nepal and the surrounding area (Appendix, Table A1) were used to conduct a bootstrapped (1000 replications) maximum parsimony analysis with MEGA v. 11 (Tamura et al. 2021) to determine the phylogenetic affinities of the specimens sequenced in this study.

Results

We collected 117 specimens representing 10 species of small mammals from two orders, Soricomorpha and Rodentia. All specimens not designated as vouchers were released at the site where they were captured. We present the distribution information for all specimens captured below providing comments on how taxa were identified and remarks on their current taxonomy.

Order Soricomorpha
Family Soricidae

***Episoriculus soluensis* Gruber, 1969**
Nepalese Brown-toothed Shrew
Figure 2B

Material examined (from previously known localities). NEPAL – **Annapurna Conservation Area** • Myagdi District, Ghorepani: 28.4015°N, 083.6980°E; 2820 m a.s.l.; 29.VII.2013; N. Pradhan; 1♀ voucher CDZ MTU-MEU31, tissue GPN41.

Remarks. This species was previously reported from Ghorepani, Annapurna Conservation Area as *E. caudatus soluensis*. Its distribution is poorly known because of only recently has it been elevated to a full species.

Identification. This is a small, red-toothed shrew possessing small fore claws (1–2 mm) and a tail shorter than head and body. *Episoriculus soluensis* may be distinguished from other species of *Episoriculus* that occur in Nepal by the length of tail relative to head and body (~81%). *Episoriculus leucops* (Horsfield, 1855) has a tail equal to or slightly longer (~105%) than head and body, *E. macrurus* (Blanford, 1888) has a tail significantly longer (~130%) than head and body, and *E. caudatus* (Horsfield, 1851) has a tail length shorter (~90%) than the head and body but longer than that of *E. soluensis* (tail ~80% of head and body). Abe (1977) reported a shorter tail (48–58 mm) in *E. soluensis* compared with a range of tail length of 62–66 mm in *E. caudatus*. The tail length of our specimen was 51 mm.

Distribution. This species has been reported to occur in Nepal and Sikkim. In Nepal, reported from elevations between 2290 and 4300 m in the Kali Gandaki Valley and Langtang area of northcentral Nepal and the Solukhumbu and Sankhuwasabha districts in northeastern Nepal. Abe (1977) indicated that this taxon was usually found at higher elevations than *E. caudatus*.

Taxonomic remarks. *Episoriculus soluensis* was considered a synonym of *E. caudatus* by Hutterer (2005) and Hoffmann and Lunde (2008), but it was recognized as a distinct species by Jenkins (2013) following the recommendation of Motokawa et al. (2009). See Jenkins (2013: 164) for a discussion of the taxonomic history of *E.*

Figure 2. A. Himalayan Shrew, *Soriculus nigrescens* (tail to head and body ratio 48%). **B.** Nepalese Brown-toothed Shrew, *Episoriculus soluensis* (tail to head and body ratio 78.5%).

soluensis. The specific status was supported by Abramov et al. (2017) and recognized by Burgin and He (2018).

***Soriculus nigrescens* (Gray, 1842)**
Himalayan Shrew
Figure 2A

Material examined (from new localities). NEPAL – **Annapurna Conservation Area** • Kaski District, Banthanti; 28.3682°N, 083.7315°E; 2330 m a.s.l.; 25.VII.2013; N. Pradhan; 1♀ voucher CDZ MTU-MEU32, tissue BTT8 • Myagdi District, Poon Hill; 28.4013°N, 083.6968°E; 2970 m a.s.l.; 27.VII.2013; N. Pradhan; 1♂ voucher CDZ MTU-MEU33, tissue GPN24 – **Manaslu Conservation Area** • Gorkha District, Namrung; 28.5439°N, 84.7700°E; 2660 m a.s.l.; 20.VII.2014; N. Pradhan; 1 sex indet. tissue NMR1, released; 1♀ voucher CDZ MTU-MEU36, tissue NMR2 • Samdo; 28.6520°N, 84.6317°E; 3825 m a.s.l.; 22.VII.2014; N. Pradhan; 1♀ voucher CDZ MTU-MEU35, tissue SAM4 • Kalsang; 28.5328°N, 84.7972°E; 2290 m a.s.l.; 25.VII.2014; N. Pradhan; 1♀ tissue KLS5.

Material examined (from previously known localities). NEPAL – **Annapurna Conservation Area** • Myagdi District, Ghorepani; 28.4015°N, 83.6980°E; 2820 m a.s.l.; 29.VII.2013; N. Pradhan; 1♀ voucher CDZ MTU-MEU34, tissue GPN42.

Identification. Red-toothed shrew that possess large fore claws (2.5–4 mm) and a short tail which is less than 60% of the head and body combined. *Episoriculus* Ellerman and Morrison-Scott, 1966 species have a greater tail-to-head and body ratio as well as markedly shorter fore claws compared to *Soriculus* Blyth, 1854.

Distribution. This species lives at mid-elevations of the Himalayas from Tibet and Nepal to Bhutan, Assam (India), and southwestern China.

Order Rodentia
Family Muridae

***Apodemus gurkha* Thomas, 1924**
Nepalese Field Mouse
Figure 3A

Material examined (from new localities) NEPAL – **Annapurna Conservation Area** • Kaski District, Banthanti; 28.3682°N, 083.7315°E; 2330 m a.s.l.; 25.VII.2013; N. Pradhan; 1 sex indet. tissue BTT4, released • Myagdi District, Poon Hill; 28.4013°N, 083.6968°E; 2970 m a.s.l.; 27.VII.2013; N. Pradhan; 2♀ tissue GPN19, GPN20; 2♂ tissue GPN18, GPN21 • Chitre; 28.4178°N, 083.6963°E; 2530 m a.s.l.; 28.VII.2013; N. Pradhan; 2♂ tissue CTR1, CTR2 – **Manaslu Conservation Area** • Gorkha District, Namrung; 28.5439°N, 084.7700°E; 2660 m a.s.l.; 20.VII.2014; N. Pradhan; 1♀ tissue NMR6 • Samagaun; 28.5873°N, 084.6389°E; 3455 m a.s.l.; 21.VII.2014; N. Pradhan; 2♀ tissue SGN1, SGN2; 1♂ tissue SGN3 • Samagaun;28.6079°N, 084.6381°E; 3590 m a.s.l.; 23.VII.2014; N. Pradhan; 2♀ tissue SGN4, SGN5 • Samdo; 28.6520°N, 084.6317°E; 3825 m a.s.l.; 22.VIII.2014; N. Pradhan; 1♀ voucher CDZ MTU-MRO51, tissue SAM3 [GenBank OK257681]; 2♂ tissue SAM1, SAM2 • Lho; 28.5741°N, 084.7031°E; 3180 m a.s.l.; 24.VII.2014; N. Pradhan; 4♀ tissue LHO10, LHO13–LHO15; 1♂ tissue LHO6; 1 sex indet. tissue LHO7.

Material examined (from previously known localities). NEPAL – **Annapurna Conservation Area** • Myagdi District, Ghorepani; 28.4026°N, 083.6978°E, 2895 m a.s.l.; 26.VII.2013; N. Pradhan; 8♀ tissue GPN2, GPN4, GPN6, GPN8–GPN10, GPN13, GPN15; 6♂ tissue GPN3. GPN5, GPN7, GPN11, GPN12, GPN14 • Ghorepani; 28.4015°N, 083.6980°E; 2820 m a.s.l.; 29.VII.2013; N. Pradhan; 5♀ tissue GPN26, GPN32, GPN37–GPN39; 6♂ tissue GPN27, GPN31, GPN33–GPN35, GPN40; 1 sex indet. tissue GPN36.

Identification. Externally *A. gurkha* is medium-sized, with soft, bluish-grey dorsal and ventral pelage. It can be distinguished from juvenile *Rattus* by the relatively small hind feet, usually 23–26 mm. *Apodemus pallipes*

(Barrett-Hamilton, 1900) has yellowish-brown dorsal and lighter ventral pelage and hind feet that are usually smaller than 23 mm. The *Cytb* sequence obtained in this study (OK257681) was found to have a 98–97% identity to *Cytb* sequences from *A. gurkha* in GeneBank and our maximum parsimony analysis recovered our specimen in a *A. gurkha* clade with high bootstrap support (Fig. 4).

Remarks. Phylogeographic examination of *Cytb* sequences from the specimens reported above indicate that more than one evolutionary significant unit may be represented among populations of Nepalese Field Mice (Pradhan 2018).

Distribution. This species lives in mid-elevation (2,200–3600 m) broadleaf and conifer forests in Central Nepal. The area of its geographic range was estimated to be 11,636 km^2 by Pearch (2011).

***Apodemus pallipes* (Barrett-Hamilton, 1900)**
Himalayan Field Mouse
Figure 3B

Material examined (from new localities) NEPAL – **Shey Phoksundo National Park** • Dolpo District, Renchi; 29.1173°N, 082.8873°E; 3030 m a.s.l.; 12.VII.2015; N. Pradhan; 1♀ tissue RCH1, 2♂ tissue RCH2, RCH3.

Material examined (from previously known localities). NEPAL – **Shey Phoksundo National Park** • Dolpo District, Ringmo; 29.1740°N, 082.9363°E; 3635 m a.s.l.; 13.VII.2015; N. Pradhan; 3♀ voucher CDZ MTU-MRO52, tissue RGM1 [GenBank: OK257682], RGM2, RGM5; 1♂ tissue RGM3 • Ringmo; 29.1690°N, 082.9402°E; 3650 m a.s.l.; 14.VII.2015; N. Pradhan; 2♀ tissue RGM7, RGM8; 2♂ tissue RGM9, RGM10.

Identification. Externally *A. pallipes* has soft yellowish-brown dorsal pelage, light-colored ventral pelage, and smaller hind feet than *A. gurkha*. There are three pairs of mammae compared to four pairs in *A. gurkha*. Our identification of *A. pallipes* was confirmed by the *Cytb* sequence OK257682, which demonstrated a 97–95% identity with *Cytb* sequences from *A. pallipes* in GenBank and was recovered in a well-supported *A. pallipes*

Figure 3A. Dorsal **and** ventral view of vouchers of the Nepalese Field Mouse, *Apodemus gurkha*, and B. the Himalayan Field Mouse, *Apodemus pallipes*.

clade in the phylogenetic analysis (Fig. 4).

Distribution. Western Himalayas in Afghanistan, southern Kyrgyzstan, northern Pakistan, northwestern India, southwestern Tibet, and western Nepal.

***Niviventer fulvescens*(Gray, 1847)**
Indochinese White-bellied Rat
Figure 5

Material examined (from new localities) NEPAL – **Annapurna Conservation Area** • Kaski District, Banthanti; 28.3682°N, 083.7315°E; 2330 m a.s.l.; 25.VII.2013; N. Pradhan; 3♀ voucher CDZ MTU-MRO57, tissue BTT9, tissue BTT2 [GenBank: OK257679], BTT5; 2♂ voucher CDZ MTU-MRO56, tissue BTT1; BTT3 • Ghorepani; 28.4015°N, 083.6980°E; 2820 m a.s.l.; 29.VII.2013; N. Pradhan; 2♀ tissue GPN28, GPN29 • Poon Hill; 28.4013°N, 083.6968°E; 2970 m a.s.l.; 27.VII.2013; N. Pradhan; 1♂ tissue GPN17 – **Manaslu Conservation Area** • Gorkha District, Lho; 28.5741°N, 084.7031°E; 3180 m a.s.l.; 24.VII.2014; N. Pradhan; 2♀ tissue LHO2, LHO8; 3♂ tissue LHO1, LHO5, LHO9 • Kalsang; 28.5328°N, 084.7972°E; 2290 m a.s.l.; 25.VII.2014; N. Pradhan; 1♀ tissue KLS1; 3♂, KLS2–KLS4.

Material examined (from previously known localities). NEPAL – **Annapurna Conservation Area** • Chitre; 28.4178°N, 83.6963°E; 2530 m a.s.l.; 28.VII,2013; N. Pradhan; 1♀ voucher CDZ MTU-MRO58, tissue CTR3; 1♂ tissue CTR5; 1 sex indet. tissue CTR4.

Identification. This species has soft, dense pelage with flattened spines; yellowish dorsal pelage, uniformly white venter, and a long tail that is usually less than 135% of the head and body combined. The tail is moderately well haired towards the tip. *Niviventer niviventer* (Hodgson, 1836) has greyish pelage and a shorter tail (115% of head and body length) with a discrete white tip. *Niviventer fulvescens* can be distinguished from *N. eha* (Wroughton, 1916) which has a smaller head and body length, longer tails (more than 140% of the head and body), and dorsal pelage that is brown and ventral pelage that is grey made up of hairs with white tips.

Remarks. The number of recognized species of *Niviventer* has increased from 17 (Musser and Carleton 2005) to 25 due to molecular analyses (Li et al. 2008; Balakirev and Rozhnov 2010; Balakirev et al. 2014; Zhang et al. 2016; Ge et al. 2018, 2020). Balakirev and Rozhnov (2010) split *N. fulvescens* into three species, including *N.*

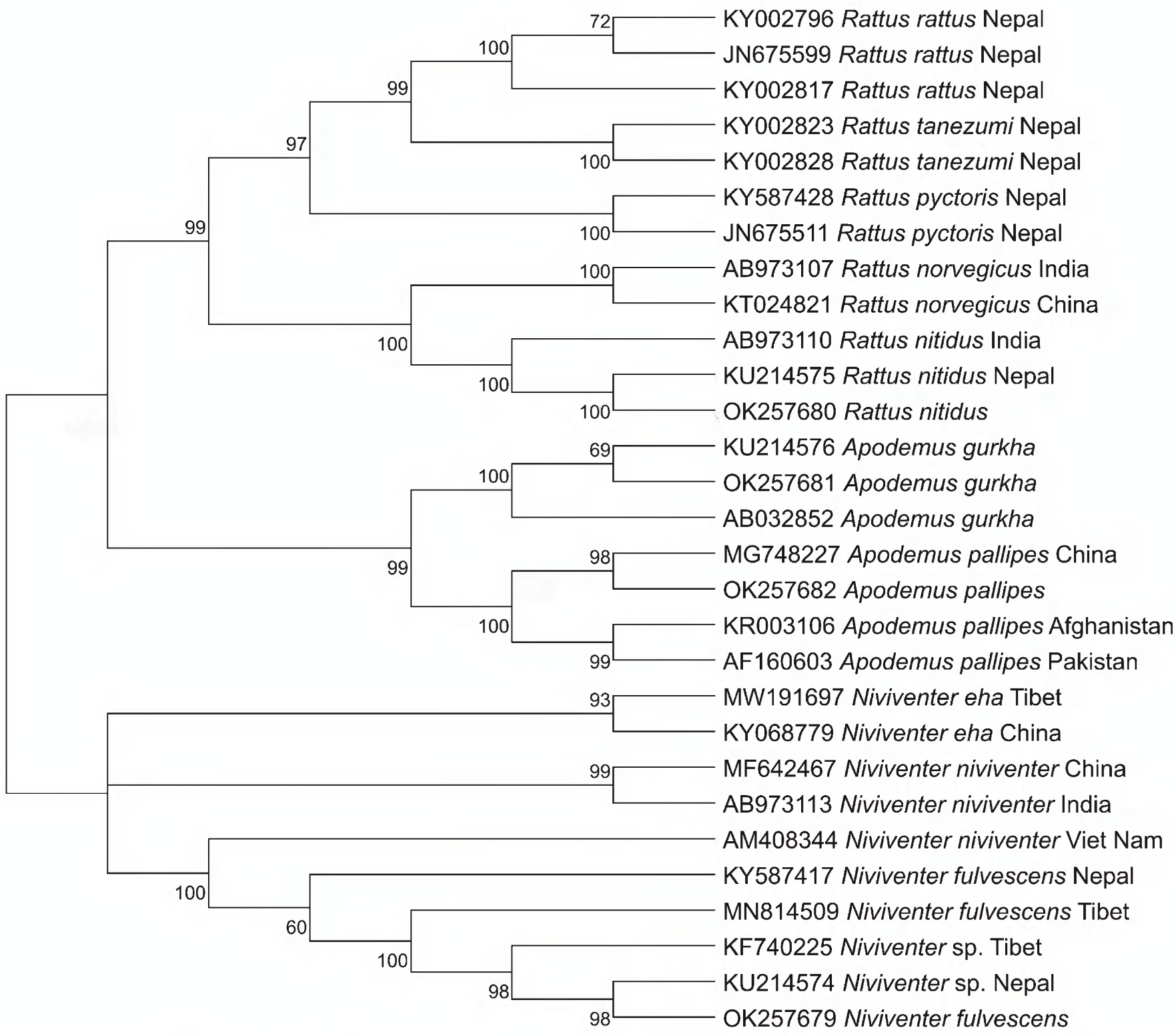

Figure 4. Maximum parsimony tree with bootstrap nodal support of *Cytb* sequences of representative taxa from Nepal and the surrounding region (Appendix, Table A1) analyzed with the sequences obtained in this study.

Figure 5. Dorsal and ventral views of vouchers of *Niviventer fulvescens* from the Annapurna Conservation Area. Tail to head and body ratios 151 and 118%.

bukit (Bonhote, 1903) and *N. huang* (Bonhote, 1905). The distributional limits and presence of additional cryptic species within *N. fulvescens* require further assessment. The *Cytb* sequence (OK257679) from our specimen from Banthanti demonstrates no differentiation from a sequence of *Niviventer* sp. (Appendix, Table A1) from Nepal (KU214574) but only a 92% identity from a specimen of *N. fulvescens* (KY587417) from Nepal. In addition, this sequence demonstrated >99% identity with sequences from *N. fulvescens* from Tibet reported by Ge et al. (2021a) and from *Niviventer* sp. 1 from Tibet reported by Lu et al. (2015). However, the low nodal support for a *N. fulvescens* clade (Fig. 4) suggests that more than one taxon may be represented among the *N. fulvescens* sequences obtained from these specimens from Nepal.

Distribution. Northern Pakistan, northern India, Nepal, Bhutan, southern China (eastern Xizang and northwest Yunnan), Myanmar, northern Vietnam, and possibly in southwestern Yunnan and Thailand.

***Rattus pyctoris* (Hodgson, 1845)**
Himalayan Rat

Material examined (from new localities) NEPAL – **Manaslu Conservation Area** • Gorkha District, Bihi; 28.5002°N, 084.8671°E; 2000 m a.s.l.; 19.VII.2014; N. Pradhan; 2♂ tissue BHI1, BHI2 • Namrung; 28.5439°N, 084.7700°E; 2660 m a.s.l.; 20.VII.2014; N. Pradhan; 1♀ tissue NMR9; 1♂ tissue NMR3.

Identification. *Rattus pyctoris* can be distinguished from *R. rattus* (Linnaeus, 1758) and *R. andamanensis* (Blyth, 1860) by the absence of broad, flat spines in the pelage. *Rattus pyctoris* can be distinguished from other *Rattus* spp. that may occur in central Nepal by its bicolored tail, dull greyish-brown dorsum, paler sides, and sharply demarcated white venter.

Distribution. Mountains of southeastern Kazakhstan, Kyrgyzstan, eastern Uzbekistan, and Tajikistan, east-central Iran, northern Afghanistan, northern Pakistan, northern India, Nepal, Bhutan, northern Bangladesh, northern Myanmar, and southern China (Yunnan, Sichuan, and Guangdong).

***Rattus rattus* (Linnaeus, 1758)**
Black Rat

Material examined (from new localities) NEPAL – **Manaslu Conservation Area** • Gorkha District, Bihi; 28.5002°N, 084.8671°E; 2000 m a.s.l.; 19.VII.2014; N. Pradhan; 1♀ tissue BHI4 • Namrung; 28.5439°N, 084.7700°E; 2660 m a.s.l.; 20.VII.2014; N. Pradhan; 2♀ tissue NMR8, NMR11; 2♂, tissue NMR7, NMR10.

Identification. *Rattus rattus* does not have a bicolored tail like *R. pyctoris*, and it possesses broad, flat spines on the dorsum and a tail which is longer than the head and body combined, unlike *R. nitidus* (Hodgson, 1845) and *R. tanezumi* Temminck, 1844.

Distribution. This species is native to the Indian subcontinent and introduced worldwide in the temperate, tropical, and subantarctic zones.

***Rattus nitidus* (Hodgson, 1845)**
White-footed Indochinese Rat

Material examined (from new localities) NEPAL – **Annapurna Conservation Area** • Kaski District, Banthanti; 28.3682°N, 83.7315°E; 2330 m a.s.l.; 25.VII.2013; N. Pradhan; 2♀, tissue BTT6 [GenBank: OK257680], BTT7.

Identification. This is a medium-sized rat very similar to *R. norvegicus* (Berkenhout, 1769) in having a similarly robust body and broad nose, but the tail is relatively shorter (90%) with respect to the head and body ratio. *Rattus nitidus* is very difficult to differentiate from Brown Rat, *R. norvegicus*, its sister taxon. The former has proportionally shorter hind feet (32–36 mm) and an overall smaller body (Burgin 2017). *Rattus nitidus* is differentiated from other species of *Rattus* that occur in Nepal by its soft dorsal and grayish ventral pelage. The *Cytb* sequence from our specimen (OK257680) is >95% in agreement with *Cytb* sequences from specimens of *R. nitidus* from Nepal and India and form a strongly supported *R. nitidus* clade (Fig. 4).

Remarks. This species was initially identified in the field as *R. norvegicus*, but Pearch (2011) failed to find any verified records of *R. norvegicus* from Nepal. Musser and Carleton (2005) concluded that given the wide distribution of *R. norvegicus* it would seem improbable for it not to occur at least in the north-central areas of Nepal.

Distribution. Northern and northeastern India, eastern Nepal, Bhutan, Myanmar, southern and central China, northern Thailand, Laos, and Vietnam. Introduced to the Philippines, central Sulawesi, northwestern New Guinea, and Palau, although it may prove to have been more widely introduced.

***Mus musculus* Linnaeus, 1758**
House Mouse
Figure 6

Material examined (from new localities) NEPAL – **Annapurna Conservation Area** • Ghorepani; 28.4029°N, 083.6995°E; 2890 m a.s.l.; 26.VII.2013; N. Pradhan; 1♀ tissue GPN1; 27.VII.2013; N. Pradhan; 2♀ tissue GPN22, GPN23 – **Manaslu Conservation Area** • Gorkha District, Bihi; 28.5002°N, 084.8671°E; 2000 m a.s.l.; 19.VII.2014; N. Pradhan; 1♂ tissue BHI3 • Namrung; 28.5439°N, 084.7700°E; 2660 m a.s.l.; 20.VII.2014; N. Pradhan; 2♂ tissue NMR4, NMR5 – **Shey Phoksundo National Park** • Dolpo District, Chepka; 29.0574°N, 082.8976°E; 2690 m a.s.l.; 15.VII.2015; N. Pradhan; 1♂ tissue CPK1.

Identification. *Mus musculus* is a small-bodied mouse with head and body length usually <100 mm and notched upper incisors. The dorsum is brownish as opposed to fawn-colored, as in *M. cervicolor* Hodgson, 1845. *Mus musculus* captured in this study were trapped close to human settlements.

Remarks. Both *M. m. domesticus* Schwarz and Schwarz, 1943 and *M. m. castaneus* Waterhouse, 1843 are reported to occur in Nepal (Pearch 2011); however, many of these reports are under older names (*dubius* Hodgson 1845, *homourus* Hodgson, 1845, *urbanus* Hodgson, 1845) that are now considered junior synonyms. Adhikari et al. (2017) verified the occurrence of both *M. m castaneus* and *M. m. bactrianus* Blyth, 1846 in Nepal from *Cytb* sequence data. Unfortunately, we did not sequence specimens of *Mus* captured in this study.

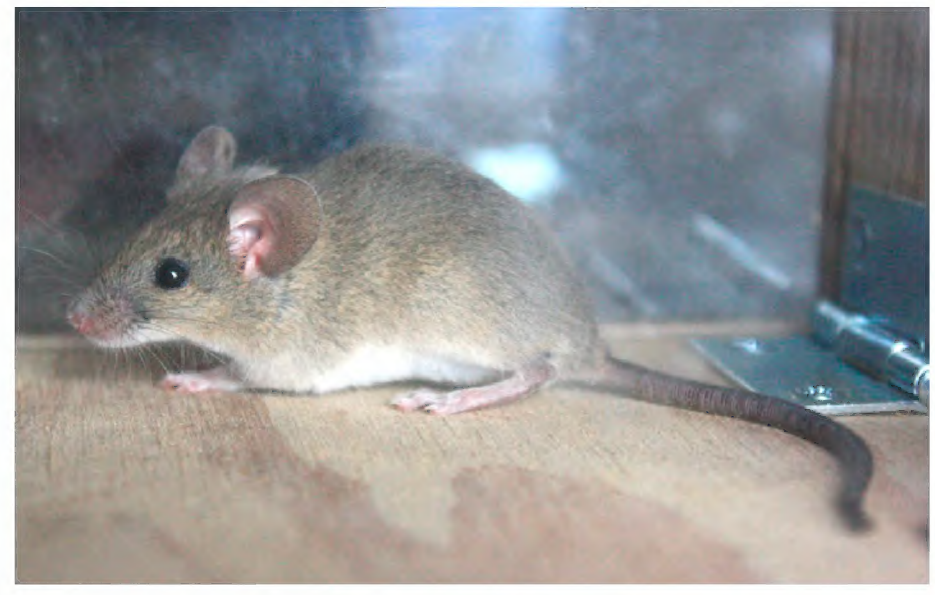

Figure 6. A House Mouse, *Mus musculus*, from Ghorepani.

Distribution. This species has been spread by association with humans to many islands and all continents except for Antarctica. It is restricted to human dwellings and human-maintained habitats in some areas, but wild populations have brcome established in other regions.

Family Cricetidae

***Neodon nepalensis* Pradhan, Sharma, Sherchan, Chhetri, Shrestha, & Kilpatrick, 2019**
Nepalese Mountain Vole
Figure 7

Material examined (from new localities) NEPAL – **Annapurna Conservation Area** • Myagdi District, Ghorepani; 28.4015°N, 083.6980°E; 2820 m a.s.l.; 29.VII.2013; N. Pradhan; 1♀ tissue GPN28.

Material examined (from previously known localities). NEPAL – **Annapurna Conservation Area** • Myagdi District, Ghorepani; 28.4026°N, 083.6978°E; 2895 m a.s.l.; 26.VII.2013; N. Pradhan: 1♂ voucher CDZ MTU-MRO53, tissue GPN16 [GenBank: MH558123] • Poon Hill; 28.4013°N, 083.6968°E; 2970 m a.s.l.; 27.VII.2013; N. Pradhan; 1♀ voucher CDZ MTU-MRO54, tissue GPN25 [GenBank: MH558124] – **Shey Phoksundo National Park** • Dolpo District, Renchi; 29.1173°N, 082.8873°E; 3030 m a.s.l.; 12.VII.2015; N. Pradhan; 1♀ tissue RCH4 [GenBank: 558125] • Ringmo; 29.1740°N, 082.9363°E; 3635 m a.s.l.; 13.VII.2015; N. Pradhan; 1♀ tissue RGM4 [GenBank: MH558126] • Ringmo; 29.1690°N, 082.9402°E; 3650 m a.s.l.; 14.VII.2015; N. Pradhan; 2♀ tissue RGM6 [GenBank: MH558127]; voucher CDZ MTU-MRO55, tissue RGM11 [GenBank MH558128].

Identification. *Neodon nepalensis* is smaller than *N. sikimensis* (Horsfield, 1841) and larger than *N. irene* (Thomas, 1911). It has a shorter tail but a higher head

Figure 7. Nepalese Mountain Vole, *Neodon nepalensis*, from Ghorepani.

and body-to-tail ratio compared to *N. sikimensis*. Compared to *N. leucurus* (Blyth, 1863), *N. nepalensis* is much smaller but with a longer tail. The ventral pelage of *N. nepalensis* is brown in contrast to the lighter venters of *N. sikimensis* and *N. irene*. The molar patterns of the m1 and M3 observed in *N. nepalensis* are simpler than those observed in *N. sikimensis* and are more similar to those observed in *N. irene*.

Distribution. West of the Trisuli River in western Nepal at elevations between 2,400–4,200 m.

Discussion

Small mammals collected during fieldwork in Nepal between 2013 and 2015 have detected a previously undescribed mountain vole, *Neodon nepalensis*, from western Nepal (Pradhan et al. 2019). This new species was reported to occur west of the Trisuli River at elevations between 2400 and 4200 m a.s.l., but the limits of its distribution remain unresolved. Poulton (2019) reported specimens from Langtang Conservation Area with *Cytb* sequences similar to specimens collected in Pipar, Annapurna Conservation Area, that likely represent *N. nepalensis* and would expand it range eastward to the slopes of the Langtang Valley.

New records from the Manaslu Conservation Area have identified the occurrences of four species (*Soriculus nigrescens*, *Niviventer fulvescens*, *Rattus pyctoris*, and *Rattus rattus*) in areas located between previously known records for these taxa from the Kali Gandaki Valley and the Langtang and Khumbu Valleys. The known range of the Nepalese endemic *Apodemus gurkha* is expanded to the east with new records from the Manaslu Conservation Area and slightly to the south with new records from the Annapurna Conservation Area. Samdo, in Manaslu Conservation Area, is the highest elevation at which *A. gurkha* has been recorded (3,825 m a.s.l.). The previous elevation record for *A. gurkha* was 3,750 m a.s.l. at Phoksundo Lake (ZFMK 84.1112). Specimens of *Apodemus pallipes* were collected in Shey Phoksundo National Park in locations between the westernmost record at Rara Lake reported by Pearch (2011) and more easterly samples from the Suli Gad Valley. Specimens of *Rattus nitidus* from the Annapurna Conservation Area expand the known range well to the west of the range reported by Pearch (2011), who gave its previously reported western limit in the Langtang and Kathmandu valleys.

Episoriculus caudatus was originally described as *Soriculus caudatus* by Horsfield (1851) who failed to designate a type specimen. A lectotype and a paralectotype were designated by Thomas (1918) and the specimen tags of these types indicate the collecting locality was Nepal (Motokawa and Lin 2005). Hinton (1922) concluded that this locality was probably inaccurate, and the type locality has been estimated to be Darjeeling, Sikkim.

In his description of *E. c. soluensis*, Gruber (1969) noted the smaller size of these specimens from Nepal (*n* = 28) compared to specimens of *E. c. caudatus* from Sikkim (*n* = 14), but Motokawa and Lin (2005) suggested that his samples of *E. c. caudatus* may have included some specimens of *E. leucops baileyi* (Thomas 1914), Abe (1977) demonstrated differences in tail, combined head and body, and condylobasal skull lengths that differentiated *E. c. caudatus* from *E c. soluensis* from Nepal. However, the sample size of *E. c. caudatus* was very small (*n* = 3). He (2018a) indicated that the morphological boundaries are not entirely clear between *E. caudatus* and *E. soluensis* and Motokawa and Lin (2005) reported no differences in cranial morphology, except for the larger skull size of the former. Motokawa and Lin (2005) pointed out that the three *E. caudatus* examined by Abe (1977) from Nepal and the lectotype from Sikkim are among the larger individuals they examined.

The distribution limits of *Episoriculus soluensis* are unclear because it has recently been elevated to a full species (Jenkins 2013). Whether recognized as a subspecies or more recently as a species, the distributional range of *E. soluensis* is reported to include Nepal and Sikkim (Motokawa et al. 2008, 2009; Abramov et al. 2017; He 2018b). In Nepal, specimens of *E. soluensis* (Table 1) have been reported from locations in the Annapurna Conservation Area and the Langtang Valley in northcentral Nepal by Abe (1977) and 10 localities in northeastern Nepal by Gruber (1969), Gregori and Petrov (1976), and Daniel and Hanzák (1985). Our review of the literature could not verify any reports of a "smaller" *E. caudatus* from Sikkim that would be assignable to *E. soluensis*. In the absence of verifiable records of *E. soluensis* in Sikkim, it should be considered endemic to Nepal. The suggestion by Abramov et al. (2017), citing Motokawa et al. (2009) as the source, that *E. caudatus* only occurs in Nepal, cannot be correct given the type locality of *E. caudatus* is Sikkim (Hinton 1922).

Acknowledgements

The Department of National Parks and Wildlife Conservation, Nepal provided collection permits. Special thanks are extended to Saurav Chhetri, and Paliza Shrestha for their assistance with the fieldwork and to Lily

Table 1. Known localities of the occurrence of *Episoriculus soluensis* in Nepal.

Province, district, or region	Locality	Elevation (m)	Number of specimens	Reference
Solukumbu	Ringmo (type locality)	2700	2	Gruber 1969
Solukumbu	Ringmo	2750	1	Gruber 1969
Solukumbu	Ringmo	3200–3250	2	Gruber 1969
Solukumbu	Basha Kola	3900–4100	5	Gruber 1969
Solukumbu	Dhud Kunt	3900	1	Gruber 1969
Solukumbu	Pike	3700	1	Gruber 1969
Bagmati	Thodung	3000–3800	6	Gruber 1969
Bagmati	Bigu	2050–3900	6	Gruber 1969
Annapurna Conservation Area	Gorapani	2730	1	Abe 1977
Annapurna Conservation Area	Ulleri	2290	1	Abe 1977
Parbat District	Chitre	2400	1	Abe 1977
Langtang Region	Ghora Tabela	2800–2980	6	Abe 1977
Langtang Region	Kyangjin Gompa	3800	6	Abe 1977
Langtang Region	Chhona	3700	5	Abe 1977
Langtang Region	Syng Gomba	3200	13	Abe 1977
Langtang Region	Gosainkund	4300	8	Abe 1977
Langtang Region	Thare Pati	3450	5	Abe 1977
Sankhuwasabha	Phematan	3450	5	Daniel and Hanzák 1985
Sankhuwasabha	Yanle Khalka	3600	3	Daniel and Hanzák 1985
Sankhuwasabha	Bhararate Himal	3800	1	Gregori and Petrov 1976

Pradhan for assistance with obtaining permits. We are grateful to the staff at the Center for Molecular Dynamics Nepal, especially Ajay Sharma, Adarsh Sherchan, Jyoti Joshi, and Priya Joshi for providing high-quality sequences. Funding was provided to NP by a Grant in Aid of Research from the American Society of Mammalogists and a grant from the Carolyn M. Glass Fund of the University of Vermont. We thank Sanjan Thapa for his constructive review of our paper and for his guidance and assistance in transferring our vouchers specimens into a publicly accessible collection in Nepal. Dr. Tej Thapa generously accessioned our vouchers into the collections at the Central Department of Zoology Museum of Tribhuvan University.

Authors' Contributions

Formal analysis: NP. Funding acquisition: NP. Investigation: NP. Project administration: CWK. Supervision: CWK. Visualization: NP. Writing – original draft: NP. Writing – review and editing: CWK.

References

Abe H (1971) Small mammals of central Nepal. Journal of the Faculty of Agriculture, Hokkaido University 55: 191–265.

Abe H (1977) Variation and taxonomy of some small mammals of central Nepal. Journal of the Mammal Society of Japan 7 (2): 63–74.

Abe H (1982) Ecological distribution and faunal structure of small mammals in central Nepal. Mammalia 46: 477–503.

Abramov AV, Bannikova AA, Chernetskaya DM, Lebedev VS, Rozhnov VV (2017) The first record of *Episoriculus umbrinus* from Vietnam with notes on the taxonomic composition of *Episoriculus* (Mammalia, Soricidae). Russian Journal of Theriology 16 (2): 117–128. https://doi.org/10.15298/rusjtheriol.16.2.01

Adhikari P, Han S-H, Kim Y-K, Kim T-W, Kim G-R, Park S-M, Lee J-W, Oh H-S (2016) List of collection and observation of small mammals in urban and wild habitats of Kathmandu, Pokhara and Lumbini, Nepal. Proceedings of the Korean Society of Environment and Ecology Conference 26 (1): 46–47.

Adhikari P, Han S-H, Kim Y-K, Kim T-W, Thapa TB, Subedi N, Adhikari P, Oh H-S (2017) First molecular evidence of *Mus musculus bactrianus* in Nepal inferred from the mitochondrial DNA *cytochrome B* gene sequences. Mitochondrial DNA Part A DNA Mapping, Sequencing, and Analysis 29 (4): 561–566. https://doi.org/10.1080/24701394.2017.1320994

Adhikari P, Han S-H, Kim Y-K, Kim T-W, Thapa TB, Subedi N, Kunwar A, Banjade M, Oh H-S (2018) New record of the oriental house rat, *Rattus tanezumi*, in Nepal inferred from mitochondrial *cytochrome B* gene sequences. Mitochondrial DNA Part B 3 (1): 386–390. http://doi.org/10.1080/23802359.2018.1436991

Aplin KP, Suzuki H, Chinen AA, Chesser RT, Have J, Donnellan SC, Austin J, Frost A, Gonzalez JP, Herbreteau V, Catzelfis F, Soubrier J, Fang Y-P, Robins J, Matisso-Smith E, Bastos ADS, Maryanto I, Sinaga MH, Denys C, Van Den Bussche RA, Conroy C, Rowe K, Cooper A (2011) Multiple geographic origins of commensalism and complex dispersal history of black rats. PLoS ONE 6 (11): e26357. https://doi.org/10.1371/journal.pone.0026357

Balakirev AE, Abramov AV, Rozhnov VV (2014) Phylogenetic relationships in the *Niviventer–Chiromyscus* complex (Rodentiia, Muridae) inferred from molecular data, with description of a new species. ZooKeys 451: 109–136. https://doi.org/10.3897/zookeys.451.7210

Balakirev AE, Rozhnov VV (2010) Phylogenetic relationships and species composition in the genus *Niviventer* (Rodentia, Muridae) based on studies of the cytochrome *b* gene of mtDNA. Moscow University Biological Sciences Bulletin 65 (4): 170–173. https://10.3103/S0096392510040139

Baral HS, Shah KB (2008) Wild mammals of Nepal. Himalayan Nature, Kathmandu, Nepal, 158 pp.

Barrett-Hamilton AEH (1900) On geographic and individual variation in *Mus sylvaticus* and its allies. Proceedings of the Royal Society of London 1900: 387–428.

Biswas B, Khajuria H (1955) Zoological results of the "Daily Mail" Himalayan Expedition 1954. Four new mammals from Khumbu, eastern Nepal. Proceedings of the Zoological Society of Bengal 8: 25–30.

Biswas B, Khajuria H (1957) Zoological results of the "Daily Mail" Himalayan Expedition 1954. Notes on some mammals of Khumbu, eastern Nepal. Proceedings of the Zoological Society of Calcutta,

Mookerjee Memorial Volume:229–253.
Burgin CJ (2017) White-footed Indochinese rat *Rattus nitidus*. In: Wilson DE, Lacher TE, Jr, Mittermeier RA (Eds.) Handbook of the mammals of the world, vol. 7. Rodents II. Lynx Edicions, Barcelona, Spain, 835.
Burgin CJ, He K (2018) Family Soricidae (shrews). In: Wilson DE, Mittermeier RA (Eds.) Handbook of the mammals of the world, Vol. 8. Insectivores, sloths, and colugos. Lynx Edicions, Barcelona, Spain, 332–551.
Chingangbam DS, Laishram JM, Suzuki H (2015) Molecular phylogenetic characterization of common murine rodents from Manipur, Northeastern India. Genes and Genetic Systematics 90 (1): 21–30. https://doi.org/10.1266/ggs.90.21
Csorba G, Kruskop SV, Borissenko AV (1999) Recent records of bats (Chiroptera) from Nepal, with remarks on their natural history. Mammalia 63 (1): 61–78. https://doi.org/10.1515/mamm.1999.63.1.61
Daniel M, Hanzák J (1985) Small mammals in eastern part of Nepal Himalaya. Rozpravy Československé Akademie Věd 95: 1–59.
Darvish J, Mohammadi Z, Ghorbani F (2015) Phylogenetic relationships of *Apodemus* Kaup, 1829 (Rodentia: Muridae) species in the eastern Mediterranean inferred from mitochondrial DNA, with emphasis on Iranian species. Journal of Mammalian Evolution 22: 583–595. https://doi.org/10.1007/s10914-015-9294-9
Ellerman JR, Morrison-Scott TCS (1966) Checklist of Palaearctic and Indian mammals 1758 to 1946. Second edition. The Trustees of the British Museum (Natural History), London, UK, 810 pp.
Frick F (1969) Die Hohenstufenverteilung der nepalischen Saugetiere. Säugetierkundliche Mitteilungen 17 (2): 161–173.
Fry TB (1925) Report No. 37a: Nepal, Bombay Natural History Society's mammal survey of India, Burma and Ceylon. Journal of the Bombay Natural Society 29: 525–530.
Ge D, Feijó A, Abramov AV, Wen Z, Liu Z, Cheng J, Xia L, Lu L, Yang Q (2021a) Molecular phylogeny and morphological diversity of the *Niviventer fulvescens* species complex with emphasis on species from China. Zoological Journal of the Linnean Society 191: 528–547. https://doi.org/10.1093/zoolinnean/zlaa040
Ge D, Feijó A, Wen Z, Abramov AV, Lu L, Cheng J, Pan S, Ye S, Xia L, Jiang X, Vogler AF, Yang Q (2021b) Demographic history and genomic response to environmental changes in a rapid radiation of wild rats. Molecular Biology and Evolution 38 (5): 1905–1923. http://doi.org/10.1093/molbev/msaa334
Ge D. Lu L, Xia L, Du Y, Wen Z, Cheng J (2018) Molecular phylogeny, morphological diversity, and systematic revision of a species complex of common wild rat species in China (Rodentia, Murinae). Journal of Mammalogy 99 (6): 1350–1374. https://doi.org/10.1093/jmammal/gyy117
Gray JE (1842) Description of some new genera and fifty unrecorded species of Mammalia. Annals and Magazine of Natural History (Series 1) 10: 255–267.
Gray JE (1847) Catalogue of the specimens and drawings of mammals and birds of Nepal and Tibet presented by B. H. Hodgson, Esq., to the British Museum. Trustees of the British Museum (Natural History), London, UK, 154 pp. https://doi.org/10.5962/bhl.title.32709
Gregori J, PetrovB (1976) Scientific results of the Yugoslav 1972 Himalaya expedition. Mammalia. Razprave. Slovenska Akademija Znanosti in Umetnosti. Classis IV: Historia Naturalis et Medicina 19: 1–20.
Gruber UF (1969) Tiergeograhische, ökologidsche und bionomische untersuchungen an kleinen säugetieren in ost-Nepal. In: Hellmich W (Ed.) Khumbu Himal. Bd. 3, Lf. 2. Universitatsverlag Wagner Ges. M.B.H., Innsbruck-München, Germany, 197–312.
Guo G, Sheng J, Wu X, Wang Y, Guo L, Zhang X, Yao H (2016) Seoul virus in the brown rat (*Rattus norvegicus*) from Urumqi, Xinjang, northwest of China. Journal of Wildlife Disease 52 (3): 705–708. https://doi.org/10.7589/2015-08-210
He K (2018a) Hodgson's brown-toothed shrew *Episoriculus caudatus*. In: Wilson DE, Mittermeier RA (Eds.) Handbook of the mammals of the world, vol. 8. Insectivores, sloths, and colugos. Lynx Edicions, Barcelona, Spain, 451.
He K (2018b) Nepalese brown-toothed shrew *Episoriculus soluensis*. In: Wilson DE, Mittermeier RA (Eds.) Handbook of the mammals of the world, Vol. 8. Insectivores, sloths, and colugos. Lynx Edicions, Barcelona, Spain, 451.
Hinton MAC (1922) Scientific results from the mammal surveys. No. XXXIII. Notes on *Soriculus nigrescens* and its subspecies. Journal of the Bombay Natural History Society 28: 1052–1055.
Hinton MAC, Fry TB (1923) Report No. 37: Nepal, Bombay Natural History Society's mammal survey of India, Burma and Ceylon. Journal of the Bombay Natural Society 29: 399–428.
Hodgson BH (1832) On the Mammalia of Nepal. Journal of the Asiatic Society of Bengal 1: 335–349.
Hodgson BH (1835) Synopsis of the Vespertilionidae of Nipal. Journal of the Asiatic Society of Bengal 4: 699–701.
Hodgson BH (1836a) Notice of seven species of Vespertilionidae observed in the Central Region of Nepal. Proceedings of the Zoological Society of London 6: 46.
Hodgson BH (1836b) Synoptical description of sundry new animals, enumerated in the Catalogue of Nipalese Mammals. Journal of the Asiatic Society of Bengal 5: 231–238.
Hodgson BH (1840) On the common hare of the Gangetic Provinces, and of the Sub-Himalaya; with a slight notice of a strictly Himalayan species. Journal of the Asiatic Society of Bengal 9: 1183–1186.
Hodgson BH (1841a) Of a new species of *Lagomys* inhabiting Nepal, (with Plate) – *Lagomys nepalensis*, Nob. Journal of the Asiatic Society of Bengal 10: 854–855.
Hodgson BH (1841b) Classified catalogue of mammals of Nepal, corrected to end of 1840, first printed in 1832. Calcutta Journal of Natural History 2: 212–221.
Hodgson BH (1841c) Notice of the Marmot of the Himalaya and of Tibet. Journal of the Asiatic Society of Bengal 10: 777–778.
Hodgson BH (1841d) New species of *Rhizomys* discovered in Nepal. Calcutta Journal of Natural History 2: 60–61.
Hodgson BH (1842) Classified catalogue of mammals of Nepal. Journal of the Asiatic Society of Bengal 10: 907–916.
Hodgson BH (1845) On the rats, mice, and shrews of the central region of Nepal. Annals and Magazine of Natural History 15: 266–270.
Hoffmann RS Lunde D (2008) Order Soricomorpha. In: Smith AT Xie Y (Eds.) A guide to the mammals of China. Princeton University Press, Princeton, USA, 297–327.
Hoofer SR, Gaschak S, Dunina-Barkovskaya Y, Makluk J, Meeks HN, Wickliffe JK, Baker RJ (2007) New information for systematics, taxonomy, and phylogeography of the rodent genus *Apodemus* (*Sylvaemus*) in Ukraine. Journal of Mammalogy 88 (2): 330–342. https://doi.org/10.1644/06-mamm-a-218r1.1
Horsfield T (1851) A catalogue of the Mammalia of the Museum of the Hon. East India Company. W.H. Allen and Co., London, UK, 212 pp.
Hutterer R (2005) Order Soricomorpha. In: Wilson DE, Reeder DM (Eds.) Mammal species of the world. A taxonomic and geographic reference. Third edition. The Johns Hopkins University Press, Baltimore, USA, 220–311.
Irwin DM, Kocher TD, Wilson AC (1991) Evolution of the cytochrome-*b* gene of mammals. Journal of Molecular Evolution 32: 128–144.
Jenkins PD (2013) An account of the Himalayan Mountain soricid community, with the description of a new species of *Crocidura* (Mammalia: Soricomorpha: Soricidae). The Raffles Bulletin of Zoology, Supplement 29: 161–175.
Jnawali SR, Baral HS, Lee S, Acharya KP, Upadhyay GP, Pandey M, Shrestha R, Joshi D, Laminchhane BR, Griffiths J, Khatiwada AP, Subedi N, Amin R (2011) The Status on Nepal Mammals: The National Red List Series, Department of National Parks and Wildlife Conservation, Kathmandu, 267 pp.

Johnson DH, Ripley SD, Thonglongya K (1980) Mammals from Nepal. Journal of the Bombay Natural History Society 77: 56–63.

Li Y, Wu Y, Harada M, Lin LK, Motokawa M (2008) Karyotypes from three rat species (Mammalia: Rodentia: Muridae) from Hainan Island, China, and the valid species status of *Niviventer lotipes*. Zoological Science 25: 686–692. https://doi.org/10.2108/zsi.25.686

Liu S-Y, He K, Chen S-D, Jin W, Murphy RW, Tang M-K, Liao R, Li F-J (2018) How many species of *Apodemus* and *Rattus* occur in China? A survey based on mitochondrial *Cyt b* and morphological analyses. Zoological Research 39 (5): 309–320. https://doi.org/10.24272/j.issn.2095-8137.2018.053

Lu L, Ge D, Chesters D, Ho SYW, Ma Y, Wen GLZ, Wu Y, Wang J, Xia L, Liu J, Guo T, Zhang X, Zhu C, Yang Q, Liu Q (2015) Molecular phylogeny and the underestimated species diversity of the endemic white-bellied rat (Rodentia: Muridae: *Niviventer*) in Southeast Asia and China. Zoologica Scripta 44: 475–494. https://doi.org/10.1111/zsc.12117

Majapuria TC, Kumar (Majapuria) R (1998) Wildlife, National Parks and Reserves of Nepal (Resources and Management). S. Devi and Tecpress Books, Bangkok, 427 pp.

Martens J, Niethammer J (1972) Die Waldmäuse (*Apodemus*) Nepals. Zeitschrift für Säugetierkunde 37: 144–154.

Mekada K, Koyasu K, Harada M, Narita Y, Shrestha KC, Oda S-L (2001) Faunal survey of small mammals in central Nepal, with reference to the distribution of the genus *Soriculus* (Insectivora, Mammalia). Biogeography 3: 33–40.

Michaux J, Chevret P, Renaud S (2007) Morphological diversity of Old World rats and mice (Rodentia, Muridae) mandible in relation with phylogeny and adaptation. Journal of Zoological Systematics and Evolutionary Research 45 (3): 263–279. http://doi.org/10.1111/j.1439-0469.2006.00390.x

Mitchell RM (1975) A checklist of Nepalese mammals (excluding bats). Säugetierkundliche Mitteilungen 23 (2): 152–157.

Mitchell RM (1977) Accounts of Nepalese mammals and analysis of the host-ectoparasite data by computer techniques. PhD dissertation, Iowa State University, Ames, USA, 558 pp.

Mitchell RM (1978) A checklist of Nepalese bats. Säugetierkundliche Mitteilungen 26 (1): 75–78.

Mitchell RM (1979) The sciurid rodents (Rodentia: Sciuridae) of Nepal. Journal of Asian Ecology 1: 21–28.

Mitchell RM (1980) New records of bats (Chiroptera) from Nepal. Mammalia 44: 339–342.

Mitchell RM, Derksen DV (1976) Additional new mammal records from Nepal. Mammalia 40: 55–61.

Molur S, Srinivasulu C, Srinivasulu B, Walker S, Nameer PO, Ravikumar L (2005) Status of South Asian non-volant small mammals: conservation assessment and management plan (C.A.M.P.). Workshop report. Zoo Outreach Organization/CBSG-South Asia, Coimbatore, India, 618 pp.

Morgulis A. Coulouris G, Raytselis Y, Madden TL, Agarwala R, Schäffer AA (2008) Database indexing for production MegaBLAST searches. Bioinformatics 24 (16): 1757–1764. http://doi.org/10.1093/bioinformatics/btn554

Motokawa M, Harada M, Mekada K, Shrestha KC (2008) Karyotypes of three shrew species (*Soriculus nigrescens*, *Episoriculus caudatus* and *Episoriculus sacratus*) from Nepal. Integrative Zoology 3: 180–185. http://doi.org/10.1111/j.1749-4877.2008.00097.x

Motokawa M, Lin L-K (2005) Taxonomic status of *Soriculus baileyi* (Insectivora, Soricidae). Mammal Study 30 (2): 117–124. http://doi.org/10.3106/1348-6160(2005)30[117:tsobi]2.0.co;2

Motokawa M, Wu Y, Harada M (2009) Karyotypes of six soricomorph species from Emei Shan, Sichuan Province, China. Zoological Science 26: 791–797. http://doi.org/10.2108/zsj.26.791

Musser GG, Brothers EM, Carleton MD, Hutterer R (1996) Taxonomy and distributional records of Oriental and European *Apodemus*, with a review of the *Apodemus-Sylvaemus* problem. Bonner Zoologische Beiträge 46: 143–190.

Musser GG, Carleton MD (2005) Superfamily Muroidea. In Wilson DE, Reeder DM (Eds.) Mammal species of the world: a taxonomic and geographic reference. Third edition. Johns Hopkins University Press, Baltimore, USA, 894–1531.

Newton PN, Rands MRW, Bowden CGR (1990) A collection of small mammals from eastern Nepal. Mammalia 54: 239–244.

Pearch MJ (2011) A review of the biological diversity and distribution of small mammal taxa in the terrestrial ecoregions and protected areas of Nepal. Zootaxa 3072: 1–286. http://doi.org/10.116461/zootaxa.3072.1

Poulton SMC (2019) Altitudinal variation in the communities of small mammals in the Central Himalaya of Nepal. PhD thesis, University of East Anglia, Norwich, UK, 410 pp.

Pradhan N (2018) Diversification of muroid rodents driven by the Late Miocene cooling. PhD dissertation, University of Vermont, Burlington, USA, 256 pp.

Pradhan N, Sharma AN, Sherchan, AM, Chhetri S, Shrestha P, Kilpatrick CW (2019) Further assessment of the genus *Neodon* and the description of a new species from Nepal. PLoS ONE 14 (7): e0219157. http://doi.org/10.1371/journal.pone.0219157

Shrestha TK (1997) Mammals of Nepal (with reference to those of India, Bangladesh, Bhutan and Pakistan). R.K. Printers, Kathmandu, Nepal, 370 pp.

Sikes RS, The Animal Care and Use Committee of the American Society of Mammalogists (2016) Guidelines of the American Society of Mammalogists for the use of wild mammals in research and education. Journal of Mammalogy 97 (3): 663–688. http://doi.org/10.1093/jmammal/gyw078

Tamura K, Stecher G, Kumar S (2021) MEGA11: Molecular Evolution Genetic Analysis version 11. Molecular Biology and Evolution 38 (7): 3022–3027. http://doi.org/10.1093/molbev/msab120

Thapa S (2014) A checklist of mammals of Nepal. Journal of Threatened Taxa 6 (8): 6061–6072. http://doi.org/10.11609/jott.o5311.6061-72

Thomas O (1918) A selection of lectotypes of Indian mammals, from the co-types described by Hodgson, Gray, Elliot and others. Journal of the Bombay Natural History Society 25: 368–372.

Thomas O (1924) On a new field-mouse from Nepal, with a note on the classification of the genus *Apodemus*. Journal of the Bombay Natural History Society 29 (4): 888–889.

Topál G (1997) A new mouse-eared bat species from Nepal with statistical analyses of some other species of the subgenus Leuconoe (Chiroptera, Verpertilionidae). Acta Zoologica Academia Scientiarum Hungaricae 43 (4): 375–402.

Weigel I (1969) Systematische Übersicht über die Insektenfresser und Nager Nepals nebst Bemerkungen zur Tiergeographie. In: Hellmich W (Ed) Khumbu Himal. Ergebnisse des Forschungsunternehmens Nepal Himalaya 3: 149–312. Universitätsverlag Wagner Ges. M. B. H., Innsbruck/München, Germany, 149–196.

Zhang B, He K, Wan T, Chen P, Sun G, Liu S, Nguyen TS, Lin L, Jiang X (2016) Multi-locus phylogeny using topotype specimens sheds light on the systematics of *Niviventer* (Rodentia, Muridae) in China. BMC Evolutionary Biology 16: 261. https://doi.org/10.1186/s12862-016-0832-8

Appendix

Dichotomous keys used to identify small mammal species in Central Nepal

Key to muroid rodents in Central Nepal

1a. Snout blunt; well-furred tail <75% of head and body; eyes small, ears rounded and barely protruding above fur ..... **Cricetidae (Arvicolinae)**
1b. Snout relatively sharp; tails naked and scaly; eyes large, ears large and protruding well above fur..... ..... **Muridae (Murinae)**

Key to Arvicolinae

1a. Eyes medium-sized to large 2
1b. Eyes small 3
2a. Pelage brownish with ash tones, relatively short stiff dorsal pelage; tail sharply bicolored; tail 33–50% of head and body ..... *Alticola roylei*
2a. Pelage light-sandy yellow to brownish, long, and silky dorsal pelage; tail laterally slightly bicolored; tail <33% of head and body ..... *Alticola stolizkanus*
3a. Head and body up to 100 mm; tail comparatively long (up to 43 mm); pelage dark 4
3b. Head and body up to 130 mm; tail comparatively short (up to 35 mm); pelage light sandy gray/brownish darkening around snout..... *Neodon leucurus*
4a. Light venter (cream buff tips); tail >40% of head and body ..... *Neodon sikimensis*
4b. Dark venter (clay-colored tips); tail ~33% of head and body ..... *Neodon nepalensis*

Key to Murinae

1a. Head and body usually <100 mm; notched upper incisors (in *Mus cervicolor* incisors not notched) ..... *Mus*
1b. Head and body usually >100 mm; upper incisors not notched 2
2a. Plantar pads 4 or 5; tail < 90% of head and body..... ..... *Millardia meltada*
2b. Plantar pads ≥6; tail variable 3
3a. Soft, dense pelage with flattened spines, no long projecting guard hairs; tail moderately well-haired towards the tip..... *Niviventer*
3b. Fur not as above (except *Rattus* have flattened spines); tail naked, scaly..... 4
4a. Head and body >140 mm; hind foot >27 mm ...*Rattus*
4b. Head and body <120mm; hind foot <26 mm .... *Apodemus*

Key to *Mus*

1a. Dorsum brownish with brown or white venter; tail variable, upper incisors notched; short rostrum <25% of skull length ..... *Mus musculus*
1b. Dorsum fawn-colored with grey or white venter; tail shorter than head and body; upper incisors not notched; longer rostrum ..... *Mus cervicolor*

Key to *Niviventer*

1a. Pelage greyish; tails <115% of head and body length, with discrete white tip..... *Niviventer niviventer*
1b. Pelage yellowish or brown; tails >115% of head and body, without white tip 2
2a. Dorsum brown; venter grey with white tips; tail >140% of head and body ..... *Niviventer eha*
2b. Dorsum yellowish; venter uniformly whitish; tail <135% of head and body ..... *Niviventer fulvescens*

Key to *Rattus*

1a. Broad, flat spines on dorsum 2
1b. Dorsum lacking broad, flat spines 3
2a. Dorsum grey-brown to black; venter grey to whitish; tail hair uniformly long; hind feet with large pads..... ..... *Rattus rattus*
2b. Dark brown dorsum and creamy underbody; tail with long guard hairs; hind feet with dense, white hairs mixed with brown hairs ..... *Rattus andamanensis*
3a. Tail bicolored, lighter below than above; fur dense; dorsum dull greyish-brown, paler along the sides, and white venter sharply demarcated ..... *Rattus pyctoris*
3b. Tail uniformly colored; dorsum and venter not sharply demarcated 4
4a. Hind feet pearly white; dorsum brownish grey; venter dull grey ..... *Rattus nitidus*
4b. Hind feet white-grey; dorsum reddish grey-brown; venter white to cream..... *Rattus tanezumi*

Key to *Apodemus*

1a. Pelage greyish; hind feet >23 mm; 4 pairs of teats..... ..... *Apodemus gurkha*
1b. Pelage yellowish-brown; hind feet <23 mm; 3 pairs of teats ..... *Apodemus pallipes*

Key to sciurids in Central Nepal

1a. Membrane of skin present between ankle and wrist.. ..... 2 (**Pteromyidae**)
1b. Membrane of skin absent between ankle and wrist; tail not distichous; throat variable, white half collar absent ..... 5 (**Sciuridae**)
2a. Tail highly distichous; interfemoral membrane absent; cheek teeth simple, brachyodont; throat white extending forward as a grey band below the eyes and the ears forming a half collar..... *Hylopetes alboniger*
2b. Tail not distichous; interfemoral membrane present; cheekteeth complex, hypsodont; half collar absent.. 3
3a. Yellowish shoulder patches present; dark-brown to blackish stripe running from head to base of tail..... ..... *Petaurista magnificus*
3b. Yellowish shoulder patches absent 4
4a. Head grey; throat pure white ..... *Petaurista caniceps*
4b. Head brown; throat brown ..... *Petaurista petaurista*
5a. Dorsal or lateral stripes present; stripes bold .... *Funambulus pennanti*
5b. Dorsal stripes absent..... 6
6a. Head and body >400 mm; ear tufts present .... *Ratufa bicolor*

6b. Head and body <300 mm; ear tufts absent 7
7a. Venter yellow with orange tips; pale patch on hips absent ..... *Dremomys lokriah*
7b. Venter grey, cream, or orange-buff; pale patch on hips ..... *Callosciurus pygerythrus*

Key to lagamorphs in Central Nepal

1a. External tail absent, ears no longer than wide ..... 2 (**Ochotonidae**)
1b. External tail present, ears longer than wide ..... *Lepus oiostolus* (**Leporidae**)
2a. Tip of nose blackish with the same color extending to and ringing lips; dorsal pelage sandy brown ..... *Ochotona curzoniae*
2b. Nose and lips not as above; dorsal pelage not as above 3
3a. Ears large and thickly furred; summer pelage brownish grey with ochre tinge; head and shoulders with smoky-yellow or brown spots; ventral pelage white to grayish white; feet white with toe pads exposed ..... *Ochotona macrotis*
3b. Not as above 4
4a. Summer dorsal pelage iron grey, dark grey or dark greyish brown; head, front, and shoulders with pale brown or reddish to bright chestnut highlights; dorsal side of ear dark greyish and hairs in ear short and sparse; ventral summer pelage white, greyish white or dark grey; upper side of foot white or dull white ... *Ochotona roylei*
4b. Not as above 5
5a. Dorsal pelage dark tea brown; dorsal side of neck and shoulders tinged with rufous-brown or dark brown spots; buffy spots behind ears; white margin of ears obscure; ventral pelage greyish yellow; upperside of feet greyish yellow or tinged with white ..... *Ochotona himalayana*
5b. Dorsum gray to brownish red with black hairs interspersed throughout the coat; base of hairs all charcoal-black; flanks straw-grey; ventral surface dull white to yellowish; ear patches dull buffy whitish; ears blackish behind with white edges; feet brownish grey ..... *Ochotona nubrica*

Key to soricids in Central Nepal

1a. Teeth pigmented ..... **Soricinae**
1b. Teeth white ..... **Crocidurinae**

Key to Soricinae

1a. Hind feet with prominent fringes of white hairs 2
1b. Hind feet lacking prominent fringes of white hairs ... 3
2a. Tail with complex fringes of white hair; silvery-white underparts sharply contrasting dark upperparts; pinnae absent ..... *Nectogale elegans*
2b. Tail without complex fringes of white hair; long silvery guard hairs on back, only slightly paler underparts compared to upperparts; pinnae small but present ..... *Chimarrogale himalayica*
3a. Five upper unicuspids ..... *Sorex minutus*
3b. Three or four upper unicuspids 4
4a. Tail <60% of head and body; fore claws large (2.5–4.0 mm) ..... *Soriculus nigrescens*
4b. Tail >60% of head and body; fore claws small (1–2 mm) 5
5a. Tail >130% of head and body *Episoriculus macrurus*
5b. Tail <105% of head and body 6
6a. Tail >60 mm long 7
6b. Tail <60 mm long ..... *Episoriculus soluensis*
7a. Hind foot <15 mm long ..... *Episoriculus caudatus*
7b. Hind foot larger than 15 mm long ..... *Episoriculus leucops*

Key to Crocidurinae

1a. Upper unicuspids 4; scattered long and erect hairs covering entire tail 2
1b. Upper unicuspids 3; scattered long and erect hairs covering 30–50% of tail from base ..... *Crocidura attenuata*
2a. Head and body <55 mm ..... *Suncus etrucus*
2b. Head and body >60 mm 3
3a. Head and body >100 mm ..... *Suncus murinus*
3b. Head and body <80 mm ..... *Suncus stoliczkanus*

Table A1. Cytochrome *b* sequence of small mammals from Nepal or surrounding areas included in analyses for species identification.

Taxon	Location	GenBank accession no.	Reference
Niviventer fulvescens	Nepal	KY587417	Adhikari et al. (unpublished)
	Tibet	MN814509	Ge et al. 2020
Niviventer sp.	Nepal	KU214574	Karmacharya et al. (unpublished)
	Nyalam, Tibet	KF740225	Lu et al. 2015
Niviventer niviventer	Viet Nam	AM408344	Michaux et al. 2007
	China, Yunnan	MF642467	Ge et al. 2018
	India, Ukhrul	AB973113	Chingangbam et al. 2015
Niviventer eha	Tibet	MW191697	Ge et al. 2021b
	China, Yunnan	KY068779	Zhang et al. 2016
Rattus rattus	Nepal, Pokhara	KY002796	Adhikari et al. 2018
	Nepal, Lumbini	KY002817	Adhikari et al. 2018
	Nepal	JN675599	Aplin et al. 2011
Rattus nitidus	Nepal	KU214575	Karmacharya et al. (unpublished)
	India	AB973110	Chingangbam et al. 2015
Rattus pyctoris	Nepal	KY587428	Adhikari et al. (unpublished)
	Nepal	JN675511	Aplin et al. 2011
Rattus tanezumi	Nepal, Lumbini	KY002823	Adhikari et al. 2018
	Nepal, Lumbini	KY002828	Adhikari et al. 2018
Rattus norvegicus	India	AB973107	Chingangbam et al. 2015
	China, Xinjiang	KT024821	Guo et al. 2016
Apodemus gurkha	Nepal	AB032852	Serizawa et al. 2000
	Nepal	KU214576	Karmacharya et al. (unpublished)
Apodemus pallipes	China	MG748227	Liu et al. 2018
	Afghanistan	KR003106	Darvish et al. 2015
	Pakistan	AF160603	Hoofer et al. 2007